Nelson Forest Region	**Retrospective Evaluation of Log Landing Rehabilitation on Coarser Textured Soils in Southeastern British Columbia** **by** **Chuck Bulmer and Mike Curran**	
	Extension Note 042	

INTRODUCTION AND BACKGROUND

In the Interior of British Columbia (BC), log landings typically occupy about 3% of the harvested area in the working forest (Thompson and Osberg 1992). If landing rehabilitation could be successfully conducted on all soil and slope conditions, it may be feasible to return as much as two-thirds of the landing areas to productive forest, and thereby increase the amount of forest land available for growing trees. Corresponding gains (up to 2%) in the Long Run Sustainable Yield and Allowable Annual Cut could also be realized.

A provincial research and extension program has been developed to define conditions where soil rehabilitation is feasible, and to identify practical and economic rehabilitation methods. One objective of the program is to evaluate past practices and make interim recommendations to guide current rehabilitation practices until results are available from new, more detailed, investigations.

Forest soil rehabilitation techniques have been evolving since the first efforts in the late 1970s. While topsoil salvage and respreading, and deep tillage, were often considered impractical in the past, these techniques are now routinely used in soil rehabilitation. Previous efforts at landing rehabilitation were often legitimately criticized for high costs, and for poor results due to ineffective tillage, regeneration problems, or other factors leading to poor productivity. Nevertheless, re-evaluating past projects shows that rehabilitation was successful on some sites, sometimes even where treatment was minimal.

- ***On log landings with coarser textured soils, even minimal soil rehabilitation and planting resulted in trees growing at rates that are similar to the rates of trees growing in undisturbed soil adjacent to the landings.***
- ***Log landing rehabilitation can succeed under certain circumstances and could be an appropriate strategy for enhancing the long-term fibre supply by restoring site productivity.***
- ***Soil rehabilitation should be encouraged on sites with fine sandy loam or coarser textured soils, and "is worth a try" on other sites.***

Retrospective study sites often represent "worst case" scenarios of rehabilitation practice and/or soil conditions. But even unsuccessful operations can provide information that will help evaluate the potential benefits of rehabilitation, and improve current practices.

This Extension Note summarizes the results of a preliminary retrospective evaluation of tree growth on some landings in the Nelson Forest Region. These landings were rehabilitated, using simple ripping teeth, during the 1980s and early 1990s by Atco Lumber Limited, Crestbrook Forest Industries Ltd., Pope and Talbot Ltd., and the Cranbrook Forest District of the BC Ministry of Forests (BCMOF). As part of a larger project that is evaluating landing rehabilitation throughout the province, the major goal in carrying out this work was to document tree growth on successfully rehabilitated landings in the Nelson Forest Region in southeastern BC. The study was conducted jointly by the BCMOF's Research Branch and the Nelson Forest Region. The outcomes are intended to provide forest managers and field

staff with insight to the potential benefits of rehabilitating soil on landings.

STUDY SITES

To provide examples of successful rehabilitation efforts, researchers and operational staff identified a number of landings where evidence of simple rehabilitation (i.e. ripped trenches) was present and planted trees had survived. Five rehabilitated landings were located on noncalcareous soils at sites in the southern ranges of the Rocky (Sage Creek), Purcell (Caven Creek), and Selkirk (Hudu Creek) mountains in Nelson Forest Region. Because the goal was simply to document the potential for growth on landings, these landings are provided only as examples of successful rehabilitation, and do not represent an unbiased sample of rehabilitated landings.

To provide examples of tree growth on calcareous (high pH) soils, two landings in the Invermere Forest District were also identified. These landings, located in the Dry Creek area, had calcareous soils and were never rehabilitated, but natural regeneration of spruce and Douglas-fir had produced a young forest on roughly one-third of the landing surface.

The sites represented a range of biogeoclimatic zones in the Nelson Forest Region: ESSFdk, MSdk, IDFdm2, and ICHmw2 (Braumandl and Curran 1992). The rehabilitated sites had gravelly sandy soils which are expected to respond well to decompaction treatments such as ripping. Topsoil and/or burnt debris piles were not respread before landings were ripped. All of the rehabilitated landings and adjacent undisturbed areas were planted or regenerated to lodgepole pine.

STUDY METHODS

At each rehabilitated landing, trees were selected for measurement by estimating the total number of trees present, then dividing by 15 (the desired sample size) to determine the spacing between measurement trees along planting rows. In most cases, this resulted in measuring every fourth or fifth tree along a planting row, after a random start, then moving on to the next row. By systematically sampling in this way, measurement trees from all portions of the landing were included. For landings that had not been rehabilitated or planted, a transect was established through the naturally regenerated forest on the outer portion of the landing. Two trees were measured adjacent to study points established every 5 m along the transect. A similar technique was used to select trees growing on undisturbed soils adjacent to the landings.

Total height and at least three internode lengths were measured on sample trees at rehabilitated landings. To determine the age of the trees at the Caven Creek site, the trees were cut down and the rings were counted because many of the trees were of natural origin. On the un-rehabilitated landings, total height, age, and length of the last three internodes were measured. Average height was plotted against age for trees on each landing and for trees growing in adjacent areas of the block.

RESULTS AND DISCUSSION

Figures 1 to 4 show tree height plotted over age for each of the rehabilitated landings, in comparison to trees growing on the block. In virtually every case, the growth rate and total height of trees growing on the rehabilitated landings were not significantly different from the growth rates on adjacent areas of the block, based on comparison of the pointwise 95% confidence intervals. These results provide examples of sites where simple ripping and planting of landings were successful. Landings with no trees were not sampled, so the overall likelihood of success of landing ripping and rehabilitation programs cannot be evaluated, even for a particular soil type. However, the results demonstrate that planting pine on

rehabilitated soils that are noncalcareous with coarse texture and low carbonate content can produce acceptable growth in the short term, and potentially produce a commercial tree crop.

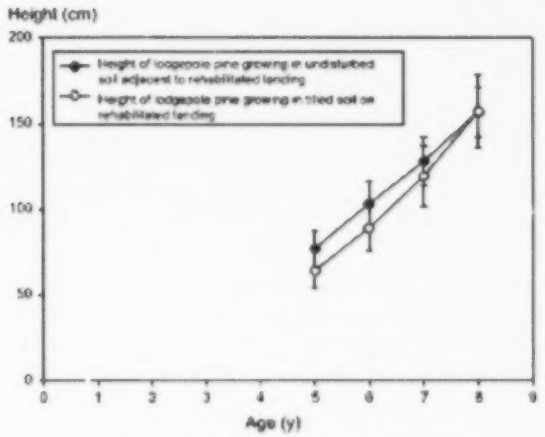

Figure 1. Sage 1 landing. Lodgepole pine growing on the ripped landing are the same height as trees growing in undisturbed soil adjacent to the landing. Error bars show pointwise 95% confidence intervals.

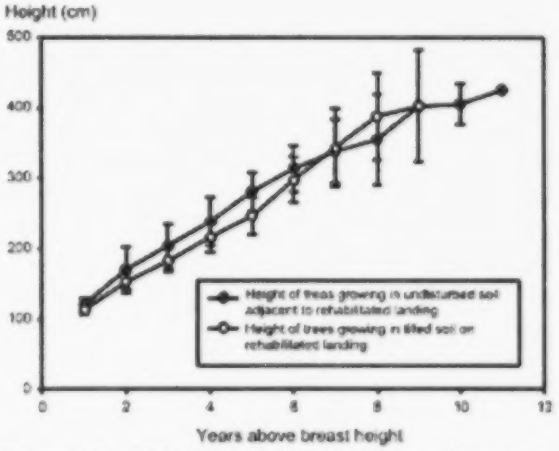

Figure 2. Sage 2 landing. Lodgepole pine growth rates on the rehabilitated landing are similar to rates for trees growing in undisturbed soil adjacent to the landing. Error bars show pointwise 95% confidence intervals.

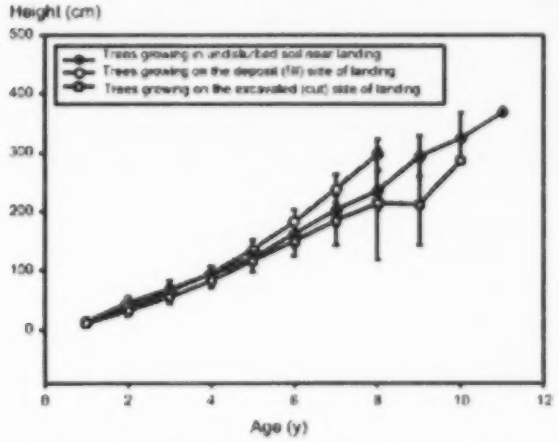

Figure 3. Caven 1 landing. Lodgepole pine on the outer portion of the landing are growing faster than on undisturbed soil. Pine on the excavated portion of the landing are growing slower. All differences are slight and non-significant. Error bars show pointwise 95% confidence intervals.

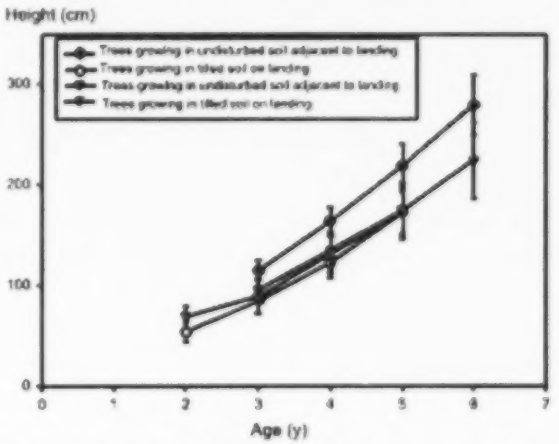

Figure 4. Hudu Creek landings. Growth rates were similar for lodgepole pine growing on the landings and in the adjacent parts of the cutblock. Error bars show pointwise 95% confidence intervals.

At the Caven Creek site (Figure 3) it was possible to sample trees growing in the excavated part of the landing, and compare them to those growing on the deposit. Trees growing in the deposit side of the landing appeared to be growing at a slightly faster rate than those on the excavated portion of the landing, suggesting that deposits provide a better growing medium than exposed subsoils. Improved tree growth on deposits may result from expected higher levels of soil organic matter, improved soil physical properties, or enhanced nutrient levels associated with the presence of topsoil in the deposit.

Compared to the height expectations for tree growth in the Nelson Forest Region (Thompson 1995, 1996), some of the individual sites were below and some were above the regional average, indicating that trees growing in undisturbed soil at some of the sites in this study may be affected by growth-limiting factors such as competing vegetation, moisture, and cold soils. For sites where productivity appears to be below the regional average, improved planting, site preparation, and rehabilitation techniques would be expected to improve growth of planted trees on both rehabilitated and undisturbed portions of the site.

On the un-rehabilitated, calcareous soil landings at the Dry Creek site, Douglas-fir initially grew at a slightly better rate on the outer portion of the landings, but growth rates on landings and undisturbed soil were similar after 10 years (Figure 5). Spruce growth rates on the landings were similar to those for undisturbed soil adjacent to the landings (Figure 6). There is considerable variation in the growth results obtained for the sites at Dry Creek, probably reflecting the high stocking levels on the naturally regenerated landings, and the limited number of samples obtained. Despite the high variability displayed, the results suggest that even under "worst case conditions" (i.e. calcareous soils, lack of rehabilitation) the outer portions of landings can support trees. The spruce growth rate appears comparable to the regional average; however, Douglas-fir growth appears to be considerably below average, perhaps reflecting an effect of the high pH soils.

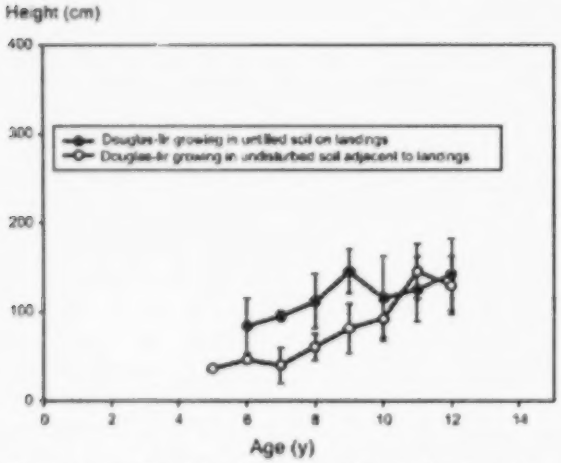

Figure 5. Dry Creek landings. Growth rates for Douglas-fir on naturally regenerated landings. The non-linearity in both lines results because different trees were used to construct the growth trends. Error bars show pointwise 95% confidence intervals

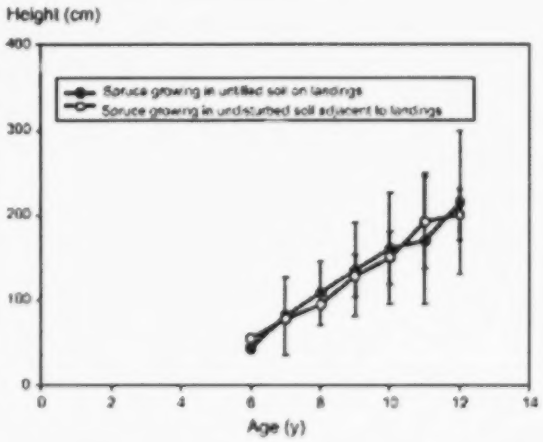

Figure 6. Dry Creek landings. Growth rates for spruce on naturally regenerated landings. Even on calcareous soils where no rehabilitation has been carried out, tree growth rates on the deposit portion of the landings are comparable to those on undisturbed soils. Error bars show pointwise 95% confidence intervals.

CONCLUSIONS

This study revealed that some rehabilitated log landing areas in the Nelson Forest Region have the potential to contribute to the productive forest landbase. In some situations, portions of unrehabilitated landings on calcareous soils also support trees, indicating that further research into soil rehabilitation on calcareous soils is justified to evaluate the circumstances under which productivity could be restored to these problem soils. Overall, the results are good news for forest managers and workers trying to maximize productivity on disturbed and rehabilitated soils in southeastern BC.

The study outcomes strongly suggest that landing ripping on coarser textured soils, in the absence of

calcareous subsoils, has the potential to restore site productivity to levels similar to those on undisturbed parts of adjacent cutblocks. On the study sites, even minimal soil treatment and planting resulted in trees growing at rates that are similar to the rates of trees growing in undisturbed soil adjacent to the landings. Success would likely be improved if topsoil was stockpiled during construction, and kept separate of the debris pile, for careful respreading afterwards.

This study focused on landings that had been successfully restocked, and so does not provide information about sites where tillage failed to produce results compatible with seedling establishment, or where other factors caused regeneration failure or early mortality. However, the observations from this study, along with a growing body of evidence from throughout BC (Bulmer 1998; Dykstra and Curran 1998; Sanborn et al 1999) support recommendations that soil rehabilitation should be encouraged on sites with fine sandy loam or coarser textured soils, and "is worth a try" on other sites.

Log landing rehabilitation can succeed under certain circumstances and could be an appropriate strategy for enhancing the long-term fibre supply. Research scientists working for the BCMOF and other agencies, along with forest industry cooperators, are establishing new research projects and operational trials to better determine the conditions under which success is likely for the diverse ecosystems throughout BC, and to evaluate the cost effectiveness of various treatment options for restoring productivity to degraded soils.

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